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**MEC299**

**EFFECT OF MICROSTRUCTURE ON STAINLESS  
STEEL DUE TO VARIABLE TEMPERATURE  
USING PLASMA CUTTING**

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## **ABSTRACT**

For this Final Year Project (FYP), the topic given is effect of microstructure on stainless steel due to variable temperature using plasma cutting. To simplify the process for this whole project is a piece of stainless will be cut using plasma cutting process. The cut part then will be bring to the lab. The surface of the cut will be examine and see using a microscope. The microstructure behaviour then will be identify and will be record. Based on the record, research about the material properties like hardness, tensile and composition for the type of microstructure seen need to be known. This process will be done using microscope, grinder and polisher machine, and hardness tester machine in the lab. The purpose of this project is to improvised the use of plasma cutting process in our industry and to determine either it is safe to use stainless steel after it has been cut using the process. If I it safe for the environment and users, then this process will have a huge impact in our manufacturing and engineering industries.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of study

Nowadays, all things around us are upgrading to a better one. This is because it can help us to ease our job. No matter what kind of work you do, they must have their own challenges. One of the scope of works that engineers are include is they need to build buildings that can be used for the people. If they want to build houses, they need to do some research about the materials needed that can ensure the safety of the users, the location of the project either it is suitable to build house or not and many more factors. They need to know the processes on how materials that they needed have been made. There are many machines in manufacturing industry. The main topics in this proposal are about plasma cutting and stainless steels.

As we all know plasma cutting is widely used now because of its benefits that we will discuss later. The first question that people who don't know about plasma cut will definitely ask what is plasma cutting process? Plasma cut is an operation that ionises a gas flow by cutting conductive materials with a high frequency and high voltage spark. Gas with high pressured is forced through a focused nozzle at high speed toward the work piece for this purpose. The electrical arc then ionises the gas, and this conductive ionised gas is known as plasma. The plasma melts the material being cut, and the high-velocity stream of ionised gas blows the molten metal away mechanically. Plasma cut can be used to cut many types of materials such as carbon steel, aluminium, stainless steel, copper, brass, cast iron, titanium and more. The plasma cutting process was found around thirty years ago for metals that were difficult to cut for machine that using traditional methods. As a heat source, it employs a high-energy stream of dissociated, ionised gas known as plasma [1].

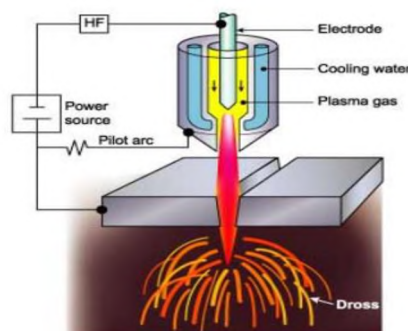


Figure 1: Illustration of plasma cutting [1]

Figure 1 shown about plasma cut mechanism. What is plasma? Plasma is a conductive ionised gas that has been made up of free electrons and positive ions. When a gas is heated to very high temperatures, it can transform into plasma. Plasma can easily flow under the influence of electrical and magnetic fields.

Hand-held and computer numerically controlled (CNC) are the two types of working systems in plasma cutting process. CNC systems are used to make precise incisions up to 150 mm thick. A triaxle CNC cutting machine is the most basic type (X, Y, Z). The Z axis is only used to determine the suitable cutting height.



Figure 2: Plasma cutting CNC machine [2]

Shown that figure 2 is a developmental functional prototype of a CNC machine. CNC cutting machines with advance six axes can be used for technologically demanding applications such as pipe cutting, profiles, and chamfer cutting to prepare surfaces for welding. A plasma torch can be mounted on a robotic arm in some applications. The stiffness and feed speed of any CNC machine are critical features. The machine feed must be smooth and consistent with the cut trajectory. The plasma cutting principle is to concentrate a large amount of power on a small area of the work piece's surface, resulting in intense surface heating [2]. One of the most serious issues that arises as a result of heat transfer from the plasma column to the work piece is deformation of the cut edges after the material has been cut and cooled. Many physical phenomena occur during the cutting operation, including heat conduction, convection, radiation effects, mechanical deformation, phase transition, and so on. The plasma cutting principle is to concentrate a large amount of power on a small area of the work piece's surface, resulting in intense surface heating.